



***Prolixus* (Acari: Trombidiformes: Tenuipalpidae) newly recorded from New Zealand: A new species from Cyperaceae and its ontogenetic patterns in chaetotaxy**

YUN XU¹ & ZHI-QIANG ZHANG^{2,3,4}

¹ Key Laboratory of Integrated Pest Management for Fujian-Taiwan Crops, Ministry of Agriculture; Fujian Provincial Key Laboratory of Insect Ecology; Fujian Agricultural and Forestry University, Fuzhou 350002, China

² Landcare Research, Private Bag 92170, Auckland, New Zealand

³ Centre for Biodiversity & Biosecurity, School of Biological Sciences, University of Auckland, Auckland, New Zealand

⁴Corresponding author: Zhi-Qiang Zhang: ZhangZ@landcareresearch.co.nz

Abstract

The genus *Prolixus* (Acari: Tenuipalpidae) was represented by two species from Australian sedges prior to this study. A new species, *Prolixus meyeri* sp. nov., is here described and illustrated from leaves of *Gahnia* (Cyperaceae) in Auckland, New Zealand. In this paper, we present the ontogenetic additions in idiosomal and leg chaetotaxy from larva to adult. A key to world species of *Prolixus* is also proposed.

Key words: Flat mite, false spider mite, Cyperaceae, *Gahnia*, ontogenetic changes

Introduction

With the rising interest in flat mites (Tenuipalpidae) recently, several new species are being described every year. The described flat mite fauna currently contains over 1100 species in 38 genera (Mesa *et al.* 2009; Beard & Ochoa 2011; Zhang *et al.* 2011; Navajas & Ochoa 2013; Beard *et al.* 2013; Beard *et al.* 2014). Ten species belonging to five genera of the Tenuipalpidae have been described from Cyperaceae: *Acaricis plana* Beard & Gerson, 2009, *A. danutae* Beard & Gerson, 2009, *A. urigersoni* Xu & Zhang, 2013, *Cyperacarus foliatus* Beard & Ochoa, 2011, *C. naomae* Beard & Ochoa, 2011, *Gahniacarus gersoni* Beard & Ochoa, 2011, *G. tuberculatus* Beard & Ochoa, 2011, *Prolixus forsteri* Beard, Fan & Walter, 2005, *P. corruginus* Beard, Fan & Walter, 2005, *Tenuipalpus obvelatus* Wang, 1983. Eight of the 10 species are from Australia, and only one species was recorded from New Zealand.

The genus *Prolixus* was erected by Beard *et al.* (2005) with only two species collected on *Gahnia aspera* from Australia and was believed to be endemic to Australia. In this paper, we describe and illustrate a new species of this genus, which is a new record to the New Zealand fauna, with samples collected from *Gahnia* (Cyperaceae) in New Zealand. The ontogenetic development of this species is examined and all the life stages and the variations in the chaetotaxy of the idiosoma and legs are presented. A key to world species of this genus is also provided.

Material and methods

Mites were mounted in Hoyer's medium, and examined at 1000 times with a DIC Leica DM5000B microscope. All measurements were made from slide-mounted specimens using a stage-calibrated ocular ruler and are given in micrometers (µm) (Zhang & Fan 2004). Measurements of the paratype as a range are presented, followed by the holotype data in parentheses. Body length was measured from the anterior margin of the prodorsum to posterior margin of the opisthosoma, and body width was measured as the greatest distance posterior to coxae II. Setae were measured from the centre of the setal base to the tip of the seta; distances between setae were measured as the distance from the centre of one setal base to the other. Legs were measured from the basal end of trochanter to the distal end of tarsus. Terminology follows that applied to the Tetranychidae by Lindquist (1985).

Diagnosis. Body elongate and slender, parallel-sided, more than four times as long as wide. Palpus 3-segmented, with setal formula 0, 2, 2. Prodorsum bearing 3 pairs of setae (v_2 , sc_1 and sc_2); setae sc_1 barbed or setiform. Opisthosoma with 8–9 pairs of dorsal setae (c_3 , d_1 , d_3 , e_1 , e_3 , f_2 , f_3 , h_2 and h_1 or c_3 , d_1 , d_3 , e_1 , e_3 , f_3 , h_2 and h_1); setae c_1 , c_2 , d_2 , e_2 absent; setae h_2 long and attenuate. Ventral setae $1a$, $1b$, $2b$, $2c$, $3a$, $4a_1$, $4a_2$, g_1 , g_2 , ps_1 and ps_2 present; setae $1c$, $3b$, $4b$ and ag present or absent; setae g_1 inserted anterior to g_2 . Adult leg chaetotaxy variable, only tibiae with stable setal formula 5, 5, 3, 3.

The original definition of *Prolixus* was based on two Australian species (Beard *et al.* 2005). The new species from New Zealand with new morphological features allows a revision of the generic diagnosis, as presented above.

***Prolixus meyeræ* sp. nov.**

(Figs. 1–15)

Diagnosis. The adult female of *Prolixus meyeræ* sp. nov. is easily distinguishable from those of the two other species by: dorsal idiosoma with series of oblique striations, forming a V-shaped pattern between setae sc_2 and d_1 , and with longitudinal striations posterior to d_1 ; setae sc_1 and c_3 short, smooth, setiform; opisthosoma with 8 pairs of dorsal setae (c_3 , d_1 , d_3 , e_1 , e_3 , f_3 , h_2 and h_1), setae e_3 , f_3 and h_1 lanceolate and barbed; ventral setae $1c$, $3b$ and $4b$ present, setae ag absent; and chaetotaxy (legs I–IV): coxae 2-2-1-1; trochanters 0-0-1-0; femora 3-3-1-1; genua 2-2-0-0; tarsi 7+ ω -7+ ω -4-4.

Type specimens. **Holotype** ♀. **New Zealand**, Auckland, Orewa, Alice Eaves Reserve, 20 Aug., 2013, by Nicholas A. Martin, ex. *Gahnia xanthocarpa* (Cyperaceae). **Paratypes.** 8 females, 3 males, 6 deutonymphs, 11 protonymphs and 5 larvae, same data as holotype; 2 females, 4 males, 3 deutonymphs, 2 protonymphs and 3 larvae, Orewa Alice Eaves Reserve, Auckland, New Zealand, 4 Jan., 2014, by Nicholas A. Martin, ex. *Gahnia setifolia* (Cyperaceae). The holotype and 37 paratypes (8 females, 5 males, 7 deutonymphs, 11 protonymphs and 6 larvae) will be deposited in the New Zealand Arthropod Collection, Landcare Research, Auckland, New Zealand (NZAC); 10 paratypes (2 females, 2 males, 2 deutonymphs, 2 protonymphs, and 2 larvae) will be deposited in the Natural History Museum, London (BNHM).

Description.

Adult Female (Figs. 1–3; n = 5)

Gnathosoma. (Figs. 1B, 2C) Infracapitulum narrowed anteriorly, reaching middle of femur I, subcapitular seta m setiform, $m=4-5$ (5), $m-m=8-9$ (8). Palp 3-segmented, setal formula: 0, 2, 2; tarsus with 2 eupathidia 2, 2.

Dorsal idiosoma. (Figs. 1A, 2A) 410–440 (410) long, 87–97 (95) wide. Body elongate. PRODORSUM mostly smooth with faint longitudinal striations mesally; bearing 3 pairs of setae (v_2 , sc_1 and sc_2); setae v_2 and sc_1 minute, smooth, setiform; sc_1 about twice as long as v_2 ; sc_2 lanceolate, barbed and about 5 times as long as sc_1 . Setal lengths: v_2 2, sc_1 3–4 (4), sc_2 15–22 (16); distances: v_2-v_2 30–38 (38), v_2-sc_1 40–42 (42), sc_1-sc_1 44–47 (45), sc_1-sc_2 44–50 (48), sc_2-sc_2 70–89 (89). OPISTHOSOMA with broad band of oblique striations, forming a series of V-shaped pattern striae or folds between setae sc_2 and d_1 ; longitudinal striations posterior to d_1 as shown in Fig. 1A; with 8 pairs of dorsal setae (c_3 , d_1 , d_3 , e_1 , e_3 , f_3 , h_2 and h_1); setae c_3 , d_3 , d_1 and e_1 smooth, setiform; setae e_3 , f_3 and h_1 lanceolate, barbed; setae h_2 elongate, ending in minute club. Lengths: d_1 6, e_1 3–4 (4), c_3 , d_3 2–3 (3), e_3 11–22 (11), f_3 15–22 (16), h_2 95–125 (125), h_1 7–10 (8); distances: d_1-d_1 23–30 (30), e_1-e_1 17–22 (20), c_3-c_3 80–89 (88), d_3-d_3 70–82 (80), d_3-e_3 83–100 (85), e_3-e_3 59–65 (63), e_3-f_3 20–23 (20), f_3-f_3 52–60 (60), f_3-h_2 27–31 (29), h_2-h_2 36–41 (41), h_2-h_1 8–11 (11), h_1-h_1 22–23 (23).

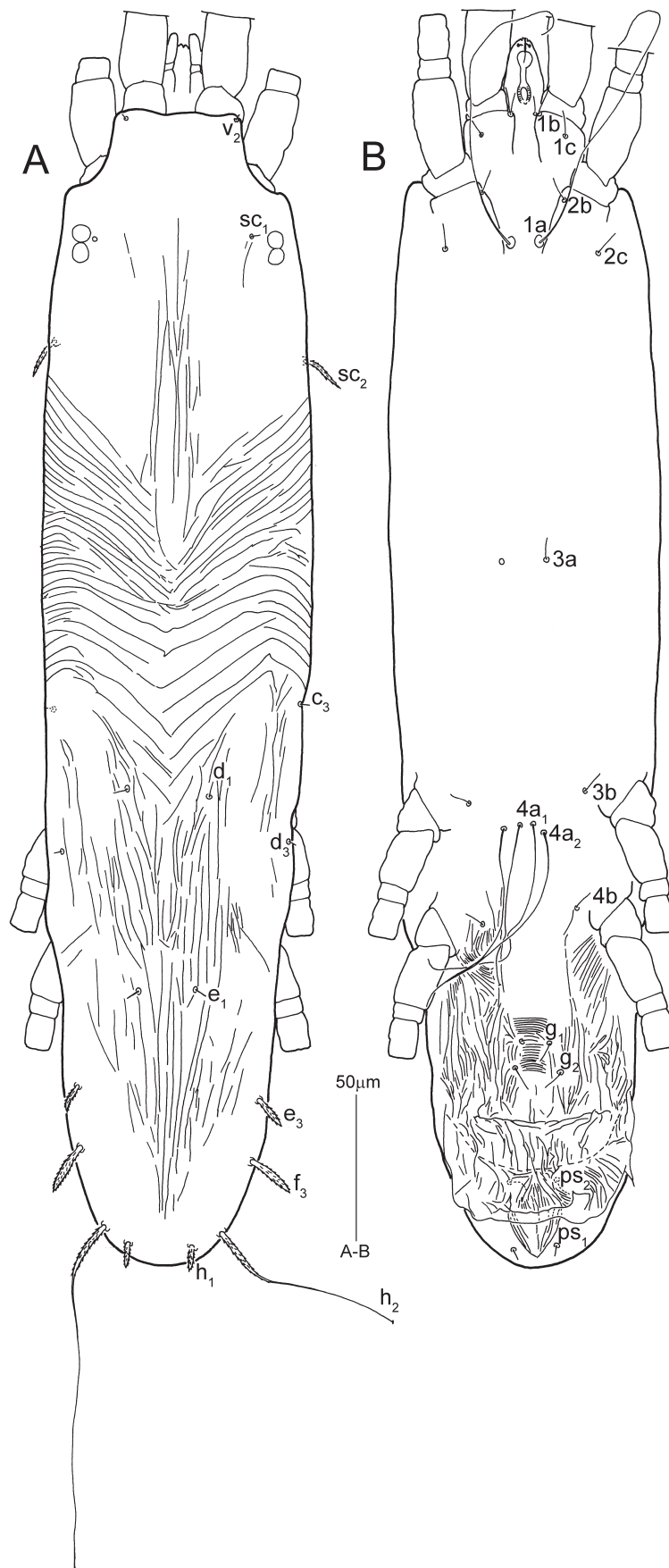


FIGURE 1. *Prolixus meyeræ* sp. nov. (adult female). A, dorsal view of idiosoma; B, ventral view of idiosoma.

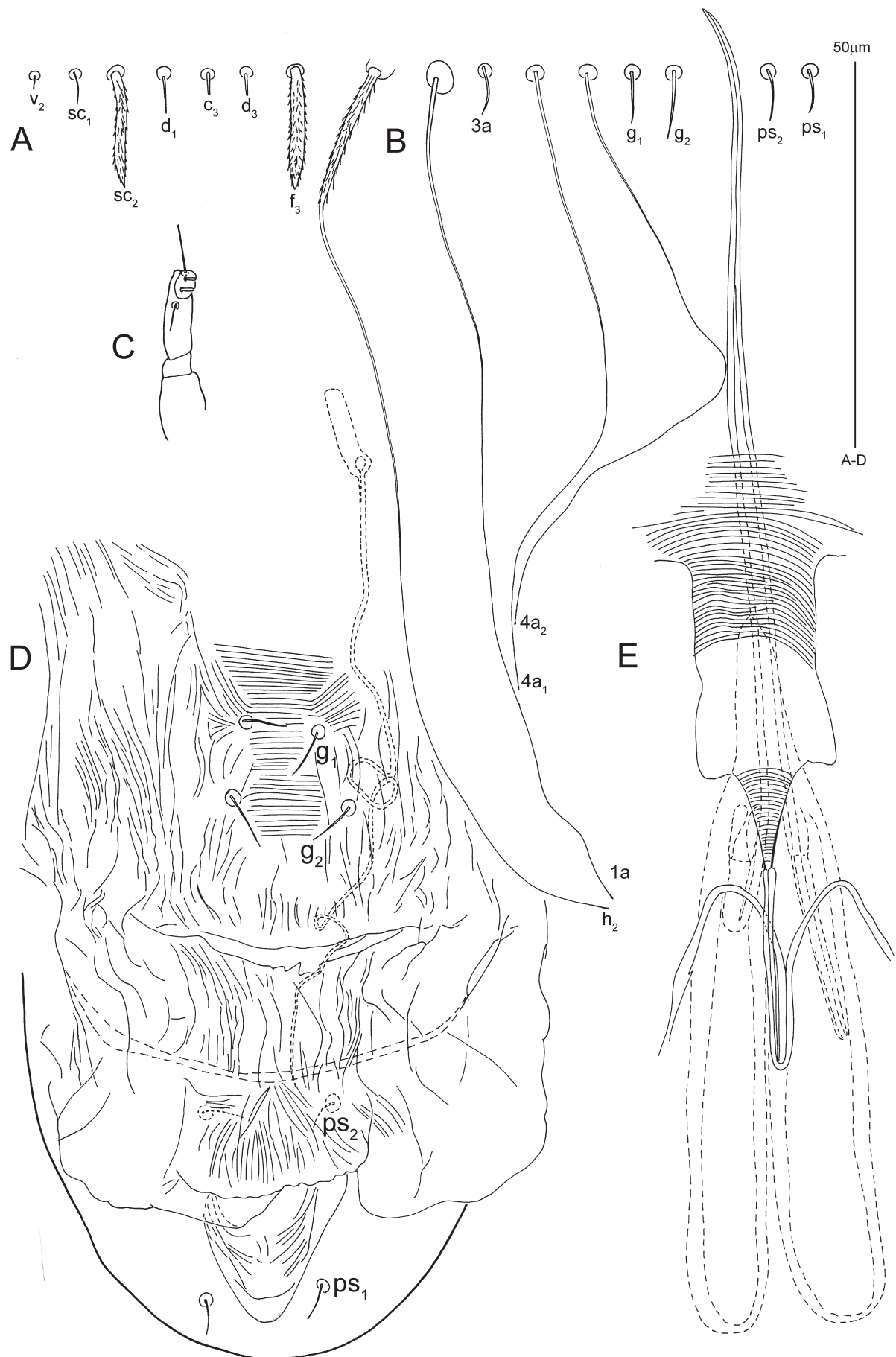


FIGURE 2. *Prolixus meyeræ* sp. nov. (adult female). A, dorsal setae; B, ventral setae; C, palp; D, posterior venter; E, chelicerae and collar.

Venter. (Figs. 1B, 2B, D) Venter with fine transverse striations between coxae II and IV. All coxal setae setiform. Setae *1a*, *4a*₁ and *4a*₂ flagelliform, *3a* setiform. Lengths: *1a* 105–125 (110), *1b* 6–7 (6), *1c* 6–7 (7), *2b* 8–10 (10), *2c* 9–10 (10), *3a* 6 (6–9), *3b* 6–7 (6), *4a*₁ 72–90 (90), *4a*₂ 60–94 (94), *4b* 6–7 (7). Distances: *1a*–*1a* 10–11 (10), *3a*–*3a* 14–16 (15), *4a*₁–*4a*₁ 4–7 (4), *4a*₁–*4a*₂ 4–5 (5), *4a*₂–*4a*₂ 13–15 (13). Posterior opisthosoma with genital flap striate; bearing 2 pairs of smooth, setiform genital setae (*g*₁ and *g*₂), subequal in length; anal area with 2 pairs of widely separated pseudanal setae (*ps*₁ and *ps*₂); aggenital setae *ag* absent. Setal lengths: *g*₁ 5–8 (6), *g*₂ 5–8 (8), *ps*₁ 4, *ps*₂ 4–6 (6). Distances: *g*₁–*g*₁ 9–12 (10), *g*₁–*g*₂ 8–15 (11), *g*₂–*g*₂ 8–15 (11), *ps*₁–*ps*₂ 23–28 (23).

Spermatheca. (Fig. 2D) A narrow, unsclerotised tube extending from genital opening (mesad setae *ps*₂) and ending in a cylinder-shaped vesicle.

Legs. (Fig. 3) Lengths of legs I–IV: 89–93 (89), 68–72 (70), 58–64 (64), 58–62 (62). Chaetotaxy: coxae 2-2-1-1; trochanters 0-0-1-0; femora 3-3-1-1; genua 2-2-0-0, tibiae 5-5-3-3, tarsi 7+ ω -7+ ω -4-4. Most dorsal and lateral setae on trochanter III, femora, genua I–II and tibiae lanceolate and barbed, lateral setae *l'* on tibiae setiform; ventral setae on femora and tibiae setiform, except *bv''* on femora I–II lanceolate and barbed. Setae *ft'* on tarsi I–IV flagelliform; unguinal setae *u* pectinate and equal in length; tectal setae *tc* smooth, setiform except *tc'* on tarsus I–II pectinate. Lengths of solenidia: ta I ω'' 4–5 (4), ta II ω'' 4–5 (4). Claws and empodium pad-like with row of paired tenent hairs.

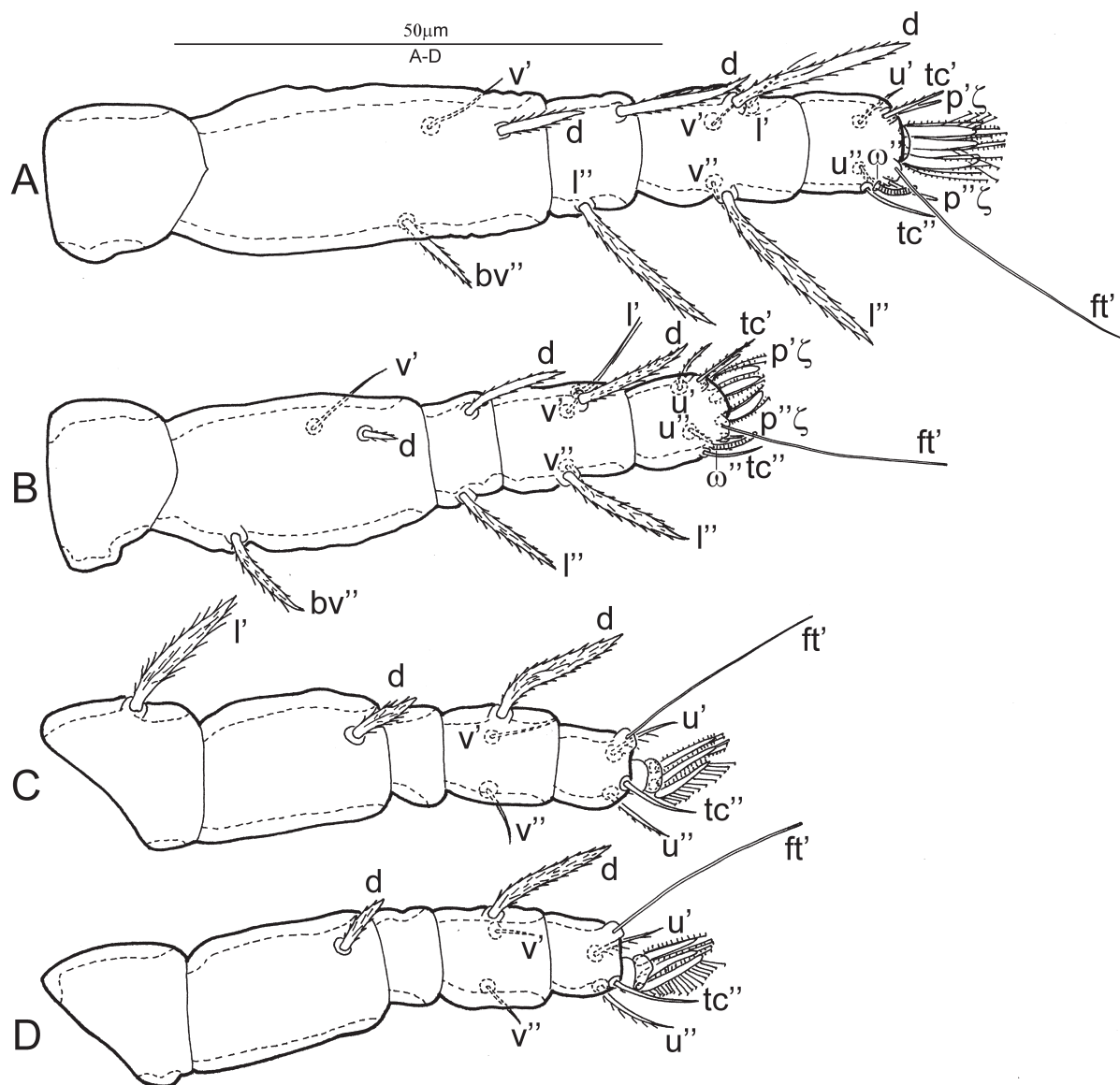


FIGURE 3. *Prolixus meyeriae* sp. nov. (adult female, right side legs). A, leg I; B, leg II; C, leg III; D, leg IV.

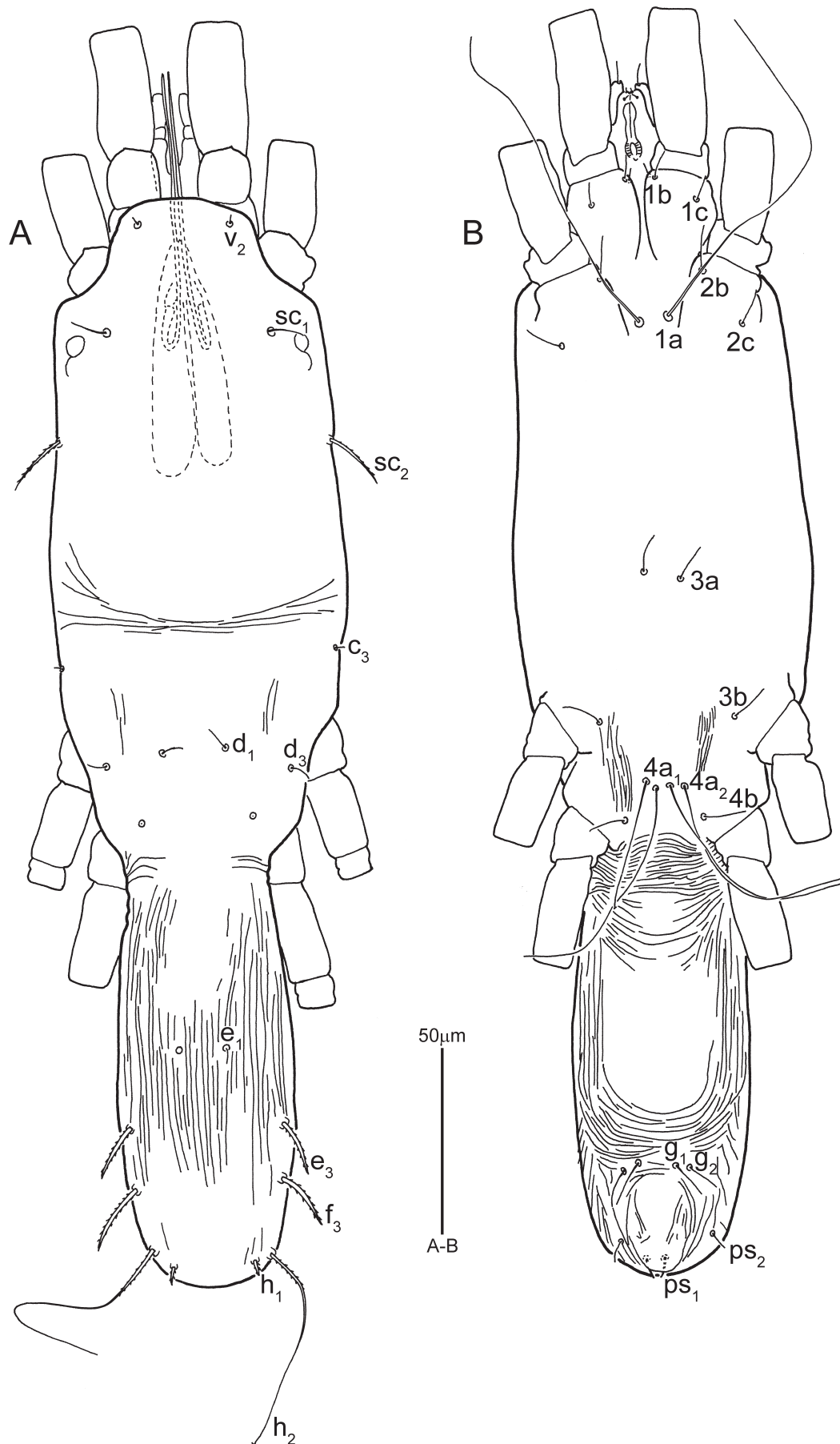


FIGURE 4. *Prolixus meyeræ* sp. nov. (adult male). A, dorsal view of idiosoma; B, ventral view of idiosoma.

Adult Male (Figs. 4–6; n=3)

Gnathosoma. (Figs. 4B, 5C) Infracapitulum narrowed anteriorly, reaching middle of femur I, subcapitular seta m setiform, $m=5-6$, $m-m=7-8$. Palp 3-segmented, setal formula: 0, 2, 2; tarsus with 2 eupathidia 2, 2.

Dorsal idiosoma. (Figs. 4A, 5B) 300–330 long, 71–82 wide. Body elongate. PRODORSUM smooth, with a narrow band of transverse striations in sejugal furrow just anterior to setae c_3 ; bearing 3 pairs of setae (v_2 , sc_1 and sc_2), setae v_2 and sc_1 setiform, sc_1 about 3 times as long as v_2 , sc_2 lanceolate and more than twice as long as sc_1 . Setal lengths: v_2 2–3, sc_1 6–9, sc_2 17–19; distances: v_2-v_2 21–25, v_2-sc_1 31–32, sc_1-sc_1 40–46, sc_1-sc_2 33–39, sc_2-sc_2 61–75. OPISTHOSOMA with narrow band of transverse striae at level of coxae IV; with 8 pairs of dorsal setae (c_3 , d_1 , d_3 , e_1 , e_3 , f_3 , h_2 and h_1); setae c_3 , d_3 , d_1 and e_1 short, setiform; setae e_3 , f_3 and h_1 lanceolate, barbed; and setae h_2 elongate, ending in minute club. Lengths: d_1 5–7, e_1 3–4, c_3 3, d_3 3–5, e_3 11–19, f_3 16–21, h_2 76–105, h_1 4–5; distances: d_1-d_1 17–22, e_1-e_1 10–17, c_3-c_3 66–76, d_3-d_3 48–50, d_3-e_3 100–110, e_3-e_3 40–42, e_3-f_3 17–20, f_3-f_3 40–42, f_3-h_2 17–22, h_2-h_2 31–33, h_2-h_1 5–7, h_1-h_1 21–24.

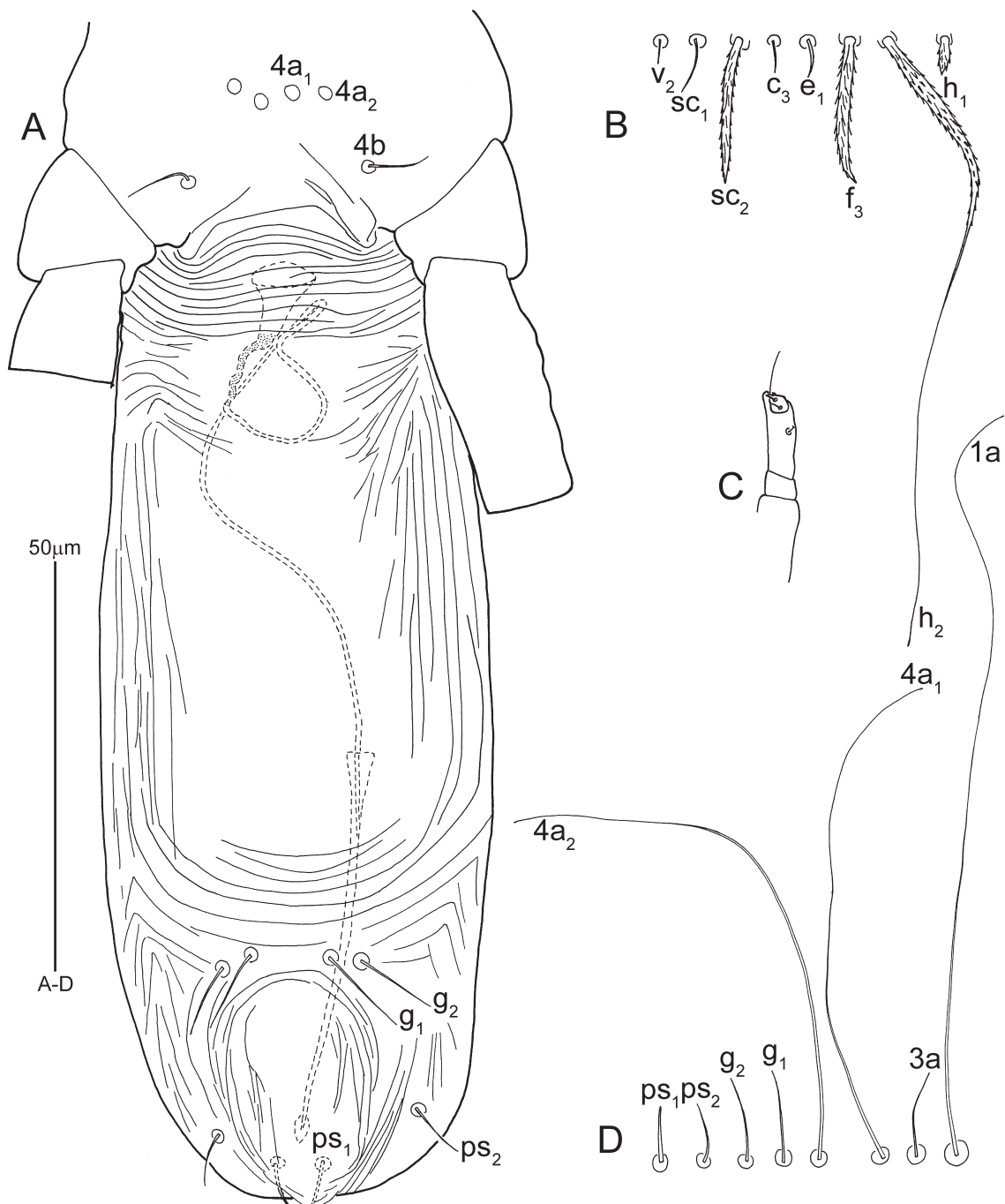


FIGURE 5. *Prolixus meyeri* sp. nov. (adult male). A, posterior venter; B, dorsal setae; C, palp; D, ventral setae.

Venter. (Figs. 4B, 5A, D) Anterior venter similar to female. All coxal setae setiform. Setae $1a$, $4a_1$ and $4a_2$ flagelliform, $3a$ setiform. Lengths: $1a$ 99–105, $1b$ 8–9, $1c$ 6–7, $2b$ 7–10, $2c$ 6–9, $3a$ 8–11, $3b$ 5–9, $4a_1$ 63–68, $4a_2$ 62–68, $4b$ 7–9. Distances: $1a$ – $1a$ 8–9, $3a$ – $3a$ 10–13, $4a_1$ – $4a_1$ 4–5, $4a_1$ – $4a_2$ 3–4, $4a_2$ – $4a_2$ 10–12. Posterior opisthosoma with an aedeagus (internal); with band of transverse striae at level of coxae IV; central region of opisthosoma with smooth cuticle, flanked by longitudinal striations laterally and transverse striae posteriorly, forming U-shaped pattern anterior to setae g_1 – g_2 ; bearing 2 pairs of setiform genital setae (g_1 and g_2) and 2 pairs of pseudanal setae (ps_1 and ps_2), ps_1 thicker than ps_2 ; aggenital setae ag absent. Setal lengths: g_1 8–9, g_2 7–10, ps_1 6–7, ps_2 5–6. Distances: g_1 – g_1 10–12, g_1 – g_2 4–5, g_2 – g_2 4–5, ps_1 – ps_2 10–13.

Aedeagus. (Fig. 5D) A narrow, elongate, sclerotised aedeagus tapering to a point posteriorly (at genital opening); membranous duct running from the sclerotised aedeagus to flared, lightly sclerotised, cone-shaped cup distally, connecting to a soft membranous vesicle.

Legs. (Fig. 6) Lengths of legs I–IV: 88–93, 68–75, 65–70, 73–74. Chaetotaxy: coxae 2-2-1-1; trochanters 0-0-1-0; femora 3-3-1-1; genua 2-2-0-0, tibiae 5-5-3-3, tarsi 7+2 ω -7+2 ω -4-4. Most dorsal and lateral setae on trochanters III, femora, genua I–II and tibiae lanceolate and barbed, lateral setae l' on tibiae setiform; ventral setae on femora and tibiae setiform, except bv'' on femur II lanceolate and barbed. Setae ft' on tarsi I–IV flagelliform; unguital setae u pectinate and equal in length; tectal setae tc smooth, setiform. Lengths of solenidia: ta I ω' 5–6, ω'' 6, ta II ω' 5, ω'' 5–6. Claws and empodium pad-like with row of paired tenent hairs.

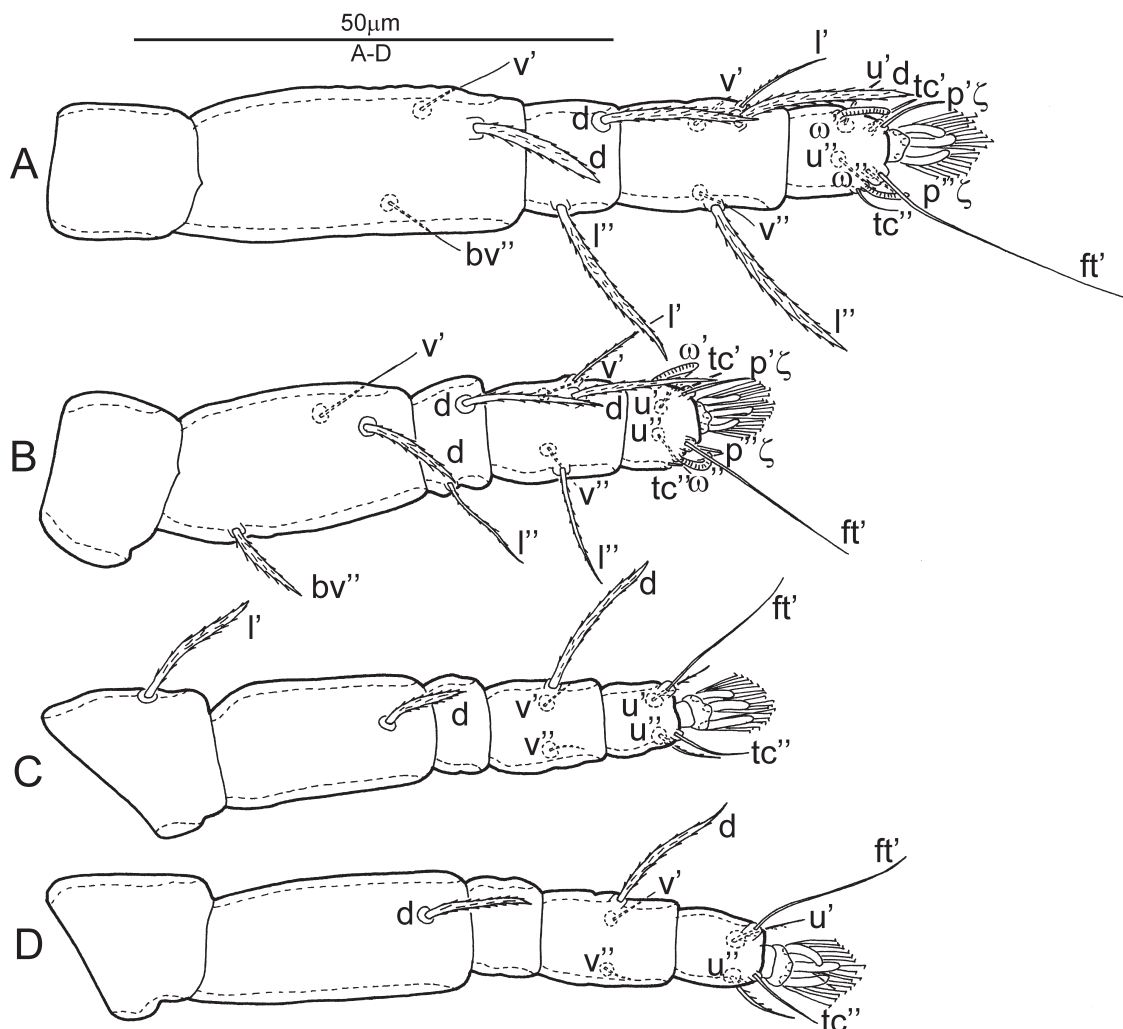


FIGURE 6. *Prolixus meyerae* sp. nov. (adult male, right side legs). A, leg I; B, leg II; C, leg III; D, leg IV.

Deutonymph (Figs. 7–9; n=5)

Gnathosoma. (Figs. 7B, 8C) Infracapitulum narrowed anteriorly, reaching middle of femur I, subcapitular seta m setiform, m =2–3, m – m =6–9. Palp 3-segmented, setal formula: 0, 2, 2; tarsus with two eupathidia 2, 2.

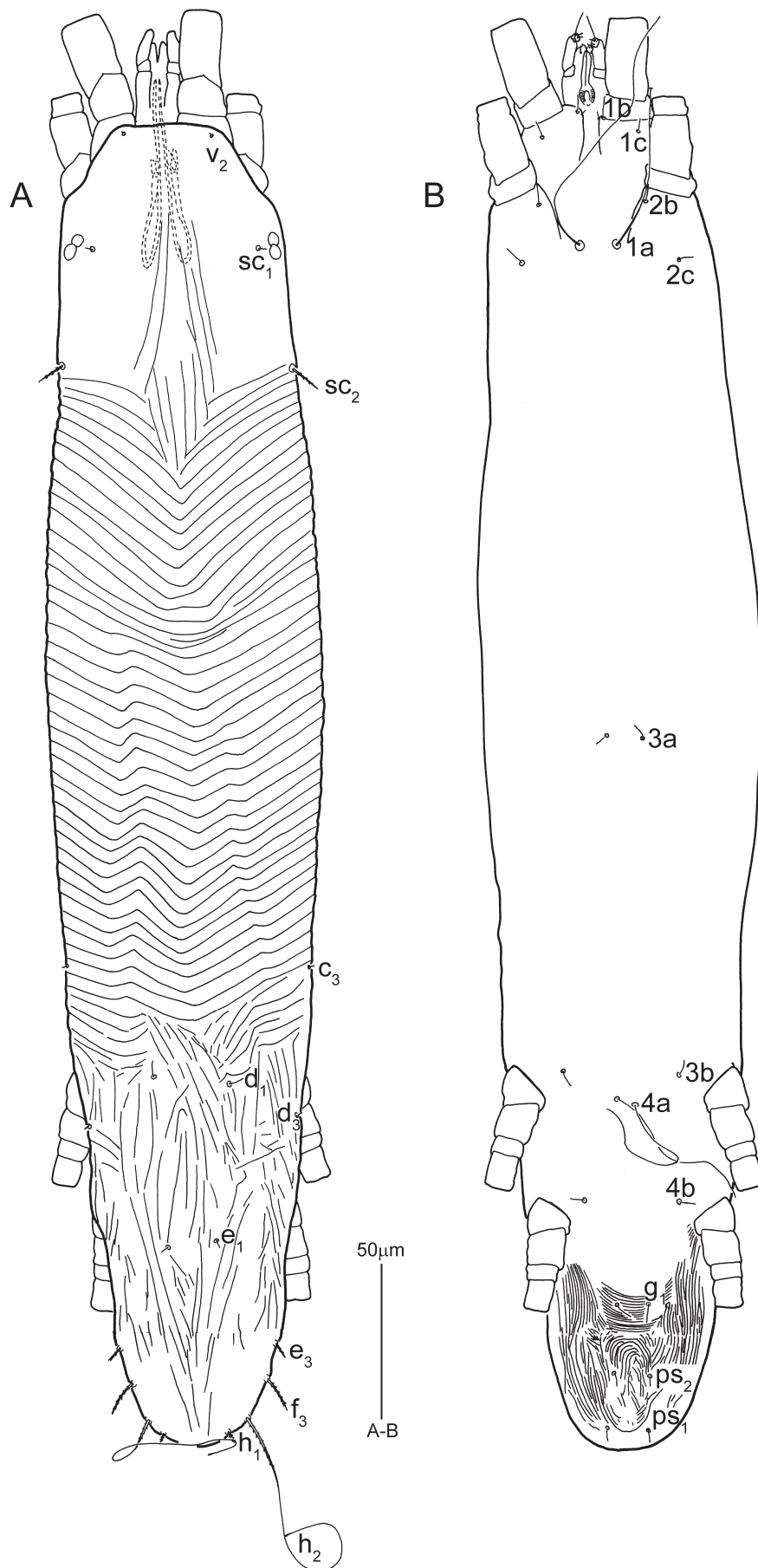


FIGURE 7. *Prolixus meyeri* sp. nov. (deutonymph). A, dorsal view of idiosoma; B, ventral view of idiosoma.

Dorsal idiosoma. (Figs. 7A, 8A) 385–450 long, 70–96 wide. Body elongate, prodorsum covered with longitudinal striae medially; body with strong corrugated transverse striations between sc_2 and d_1 , and weak, broken longitudinal striae posterior to d_1 . PRODORSUM bearing 3 pairs of setae (v_2 , sc_1 and sc_2), setae v_2 and sc_1 setiform, minute; setae sc_2 lanceolate and more than 2.5 times as long as sc_1 . Setal lengths: v_2 1–2, sc_1 3–5, sc_2 10–12; distances: v_2 – v_2 30–31, v_2 – sc_1 31–40, sc_1 – sc_1 55–57, sc_1 – sc_2 38–44, sc_2 – sc_2 77–86. OPISTHOSOMA with same setae as adults; setae c_3 , d_3 , d_1 and e_1 setiform, minute; setae e_3 and f_3 lanceolate, barbed; setae h_1 minute, barbed; and setae h_2 elongate, ending in minute club. Lengths: d_1 6–7, e_1 3–4, c_3 2, d_3 2, e_3 4–9, f_3 8–13, h_2 92–105, h_1 4–5; distances: d_1 – d_1 19–25, e_1 – e_1 16–17, c_3 – c_3 80–84, d_3 – d_3 68–72, d_3 – e_3 66–80, e_3 – e_3 50–51, e_3 – f_3 10–14, f_3 – f_3 43–44, f_3 – h_2 10–15, h_2 – h_2 30–32, h_2 – h_1 4–7, h_1 – h_1 19–21.

Venter. (Figs. 7B, 8B, D) Similar to female. All coxal setae setiform. Setae $1a$ and $4a_1$ flagelliform, $3a$ setiform. Lengths: $1a$ 67–93, $1b$ 6–7, $1c$ 5–6, $2b$ 6–7, $2c$ 6–7, $3a$ 4–6, $3b$ 5–7, $4a_1$ 60–67, $4b$ 6–7. Distances: $1a$ – $1a$ 12–16, $3a$ – $3a$ 13–14, $4a_1$ – $4a_1$ 5–6. Posterior opisthosoma with transverse striae surrounding setae g_1 , and longitudinal striations laterally; bearing 1 pair of genital setae (g_1) and 2 pairs of pseudanal setae (ps_1 and ps_2); aggenital setae ag absent. Setal lengths: g_1 5–7, ps_1 4–5, ps_2 4. Distances: g_1 – g_1 10, ps_1 – ps_2 16–18.

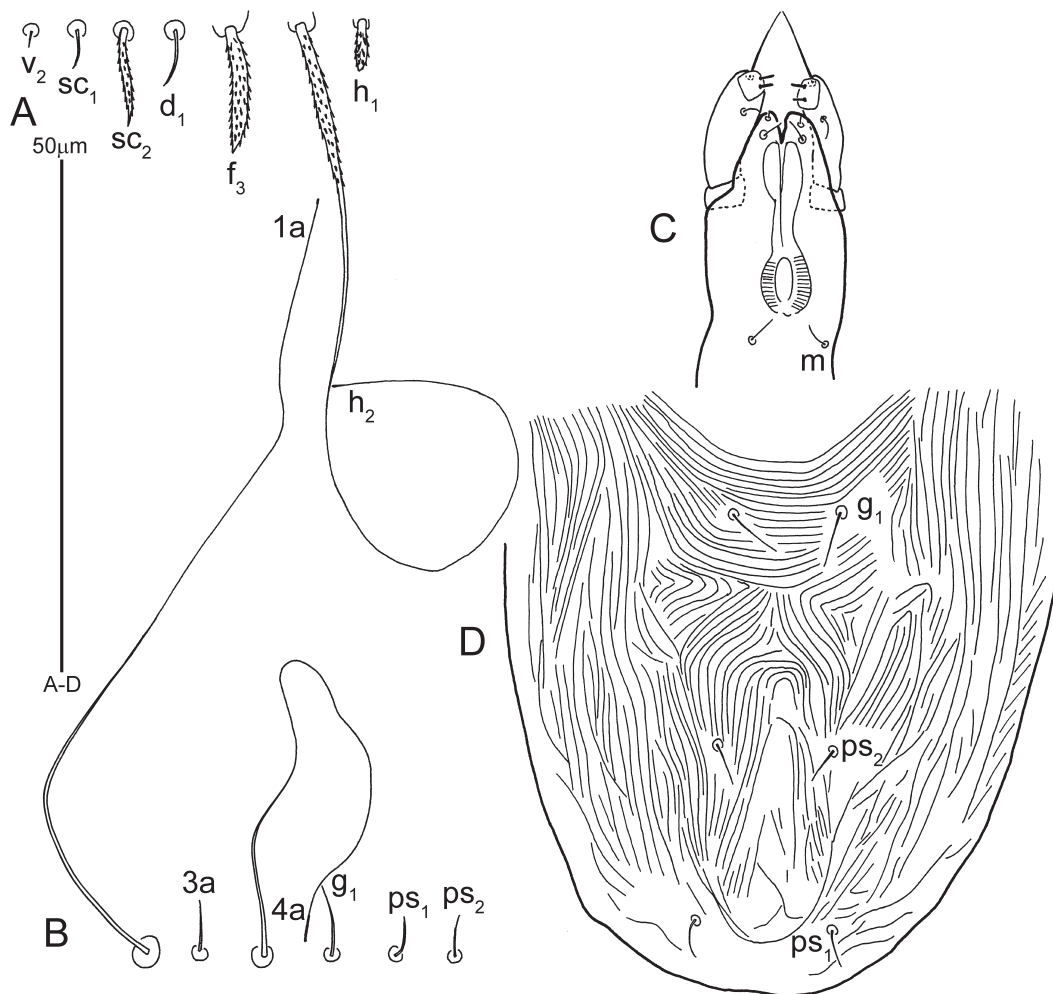


FIGURE 8. *Prolixus meyeriae* sp. nov. (deutonymph). A, dorsal setae; B, ventral setae; C, ventral aspect of distal infracapitulum; D, posterior venter.

Legs. (Fig. 9) Lengths of legs I–IV: 61–68, 48–52, 40–46, 39–44. Chaetotaxy: coxae 2-2-1-1; trochanters 0-0-1-0; femora 3-3-1-1; genua 2-2-0-0, tibiae 5-5-3-3, tarsi 7+ ω -7+ ω -4-4. Most dorsal and lateral setae on trochanter III, femora, genua I–II and tibiae lanceolate and barbed, though lateral setae l' on tibiae setiform. Ventral setae on femora and tibiae setiform, except bv'' on femur II lanceolate and barbed. Setae ft' on tarsi I–IV flagelliform; unguital setae u and tectal setae tc setiform. Lengths of solenidia: ta I ω'' 4, ta II ω'' 4. Claws and empodium pad-like with row of paired tenent hairs.

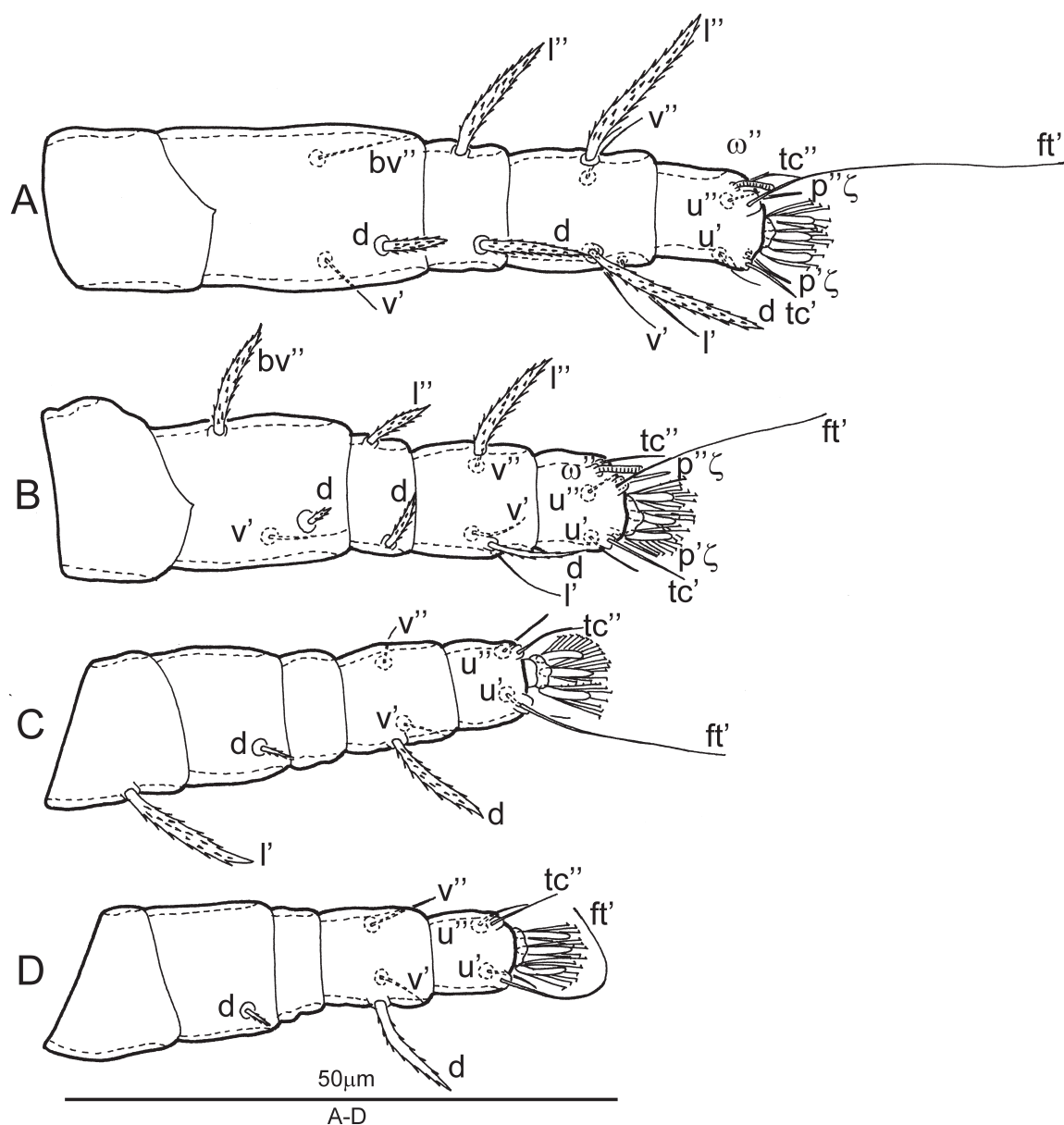


FIGURE 9. *Prolixus meyerae* sp. nov. (deutonymph, left side legs). A, leg I; B, leg II; C, leg III; D, leg IV.

Protonymph (Figs. 10–12; n=5)

Gnathosoma. (Figs. 10B, 11D) Infracapitulum narrowed anteriorly, reaching middle of femur I, subcapitular seta *m* setiform, $m=2-3$, $m-m=6-7$. Palp 3-segmented, setal formula: 0, 2, 2; tarsus with two eupathidia 2, 2.

Dorsal idiosoma. (Figs. 10A, 11B) 285–345 long, 72–78 wide. Body elongate, similar to deutonymph, prodorsum with longitudinal oblique striae medially; body with strong corrugated transverse striations between sc_2 and d_1 , and longitudinal striae posterior to d_1 . PRODORSUM bearing 3 pairs of setae (v_2 , sc_1 and sc_2), setae v_2 and sc_1 minute, setiform; setae sc_2 lanceolate and more than 2.5 times as long as sc_1 . Setal lengths: v_2 1–2, sc_1 3–5, sc_2 8–10; distances: v_2-v_2 22–25, v_2-sc_1 30–34, sc_1-sc_1 43–46, sc_1-sc_2 28–40, sc_2-sc_2 65–67. OPISTHOSOMA with same setae as adults. Setae c_3 , d_3 , d_1 and e_1 smooth, minute; setae e_3 and h_1 short, barbed; setae f_3 lanceolate, barbed; and setae h_2 elongate, ending in minute club. Lengths: d_1 5–6, e_1 2–3, c_3 1–2, d_3 1–2, e_3 3–4, f_3 5–7, h_2 84–91, h_1 3; distances: d_1-d_1 13–20, e_1-e_1 12–14, c_3-c_3 63–67, d_3-d_3 50–55, d_3-e_3 46–56, e_3-e_3 33–35, e_3-f_3 7–9, f_3-f_3 29–30, f_3-h_2 6–9, h_2-h_2 20–22, h_2-h_1 4–5, h_1-h_1 11–14.

Venter. (Figs. 10B, 11A, C) Similar to deutonymph. All coxal setae setiform. Setae $1a$ flagelliform, $3a$ setiform. Lengths: $1a$ 63–74, $1b$ 5–7, $1c$ 5–7, $2b$ 8–10, $3a$ 6–8, $3b$ 5–7. Distances: $1a-1a$ 9–10, $3a-3a$ 10–12. Posterior opisthosoma with 2 pairs of pseudanal setae (ps_1 and ps_2), setiform and subequal in length; aggenital and genital setae absent. Setal lengths: ps_1 3–4, ps_2 3. Distances: ps_1-ps_2 9–10.

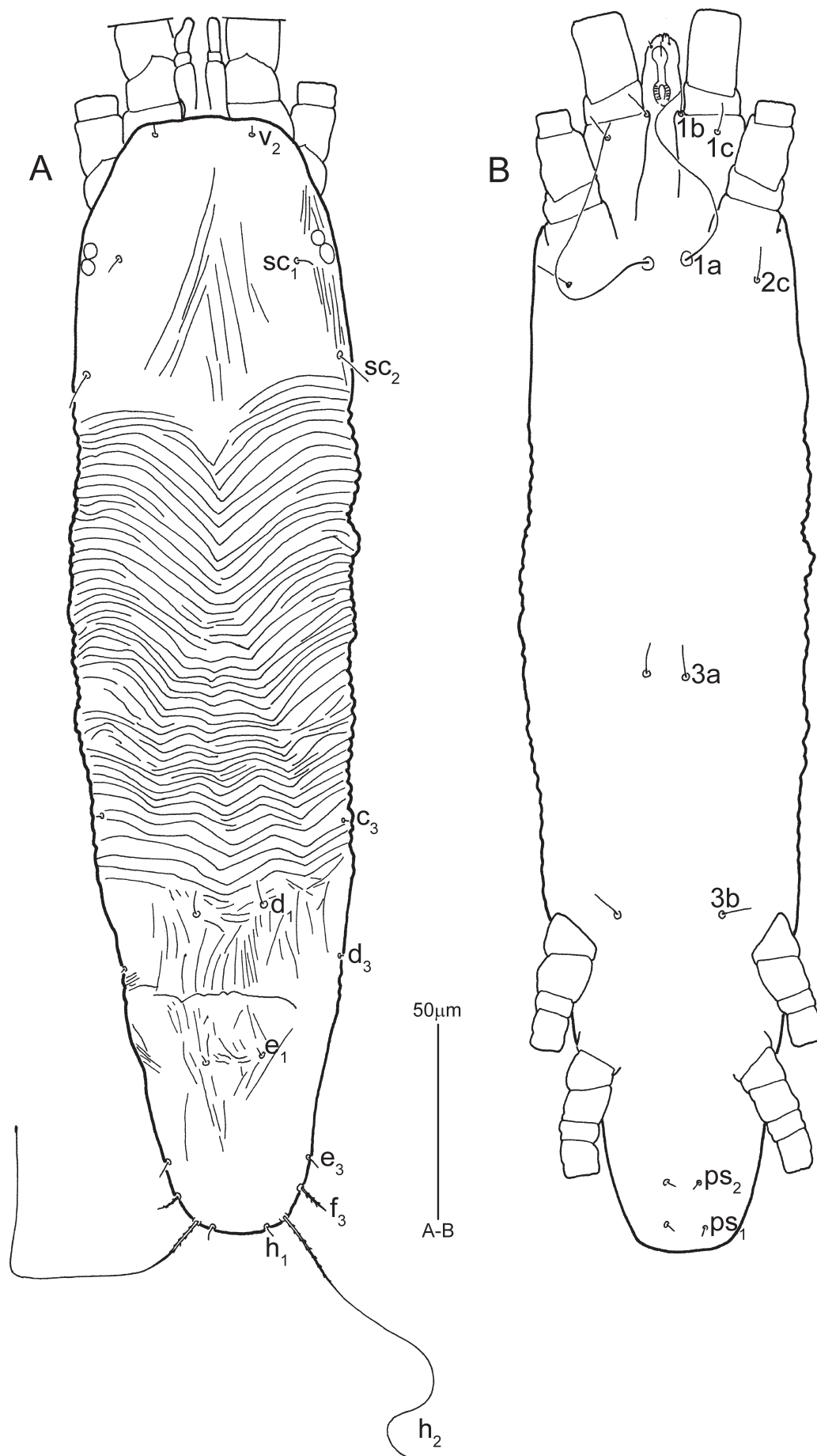


FIGURE 10. *Prolixus meyeræ* sp. nov. (protonymph). A, dorsal view of idiosoma; B, ventral view of idiosoma.

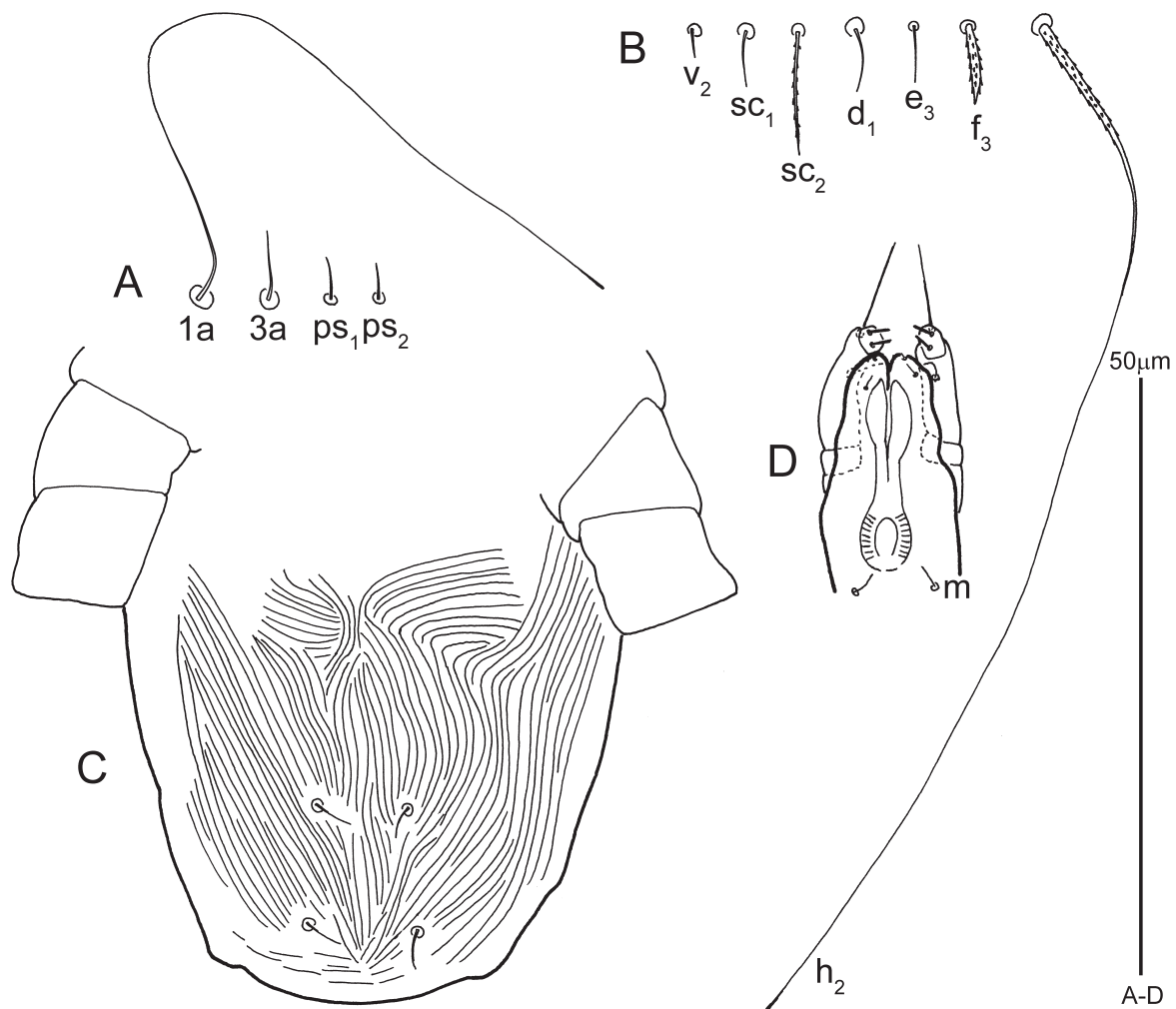


FIGURE 11. *Prolixus meyeri* sp. nov. (protonymph). A, dorsal setae; B, ventral setae; C, posterior venter; D, ventral aspect of distal infracapitulum.

Legs. (Fig. 12) Lengths of legs I–IV: 53–55, 43–44, 38–40, 36–38. Chaetotaxy: coxae 2-1-1-0; trochanters 0-0-1-0; femora 3-3-1-1; genua 1-1-0-0, tibiae 5-5-3-3, tarsi $7+\omega-7+\omega-4-3$. Most dorsal and lateral setae on trochanter III, femora I–II, genua I–II and tibiae lanceolate and barbed. Dorsal setae *d* on femora III–IV short, rod-shaped and lateral setae *l'* on tibiae I–II setiform. Ventral setae on femora I–II and tibiae setiform, except *bv''* on femora I pectinate, and *bv''* on femora II lanceolate, barbed. Setae *ft'* on tarsi I–IV flagelliform; ungual setae *u* and tectal setae *tc* setiform. Lengths of solenidia: ta I ω'' 3, ta II ω'' 3. Claws and empodium pad-like with row of paired tenent hairs.

Larva (Figs. 13–15; n=5)

Gnathosoma. (Figs. 13B, 14C) Infracapitulum narrowed anteriorly, reaching middle of femur I, subcapitular seta *m* setiform, *m*=3, *m*–*m*=7–8. Palp 3-segmented, setal formula: 0, 2, 2; tarsus with two eupathidia 2, 1–2.

Dorsal idiosoma. (Figs. 13A, 14A) 200–260 long, 45–57 wide. Body elongate. PRODORSUM with mostly longitudinal striae, with oblique to transverse striae posteriorly; bearing 3 pairs of setae (*v*₂, *sc*₁ and *sc*₂); setae *v*₂ and *sc*₁ minute, smooth; setae *sc*₂ smooth, setiform, about twice as long as *sc*₁. Setal lengths: *v*₂ 2, *sc*₁ 3, *sc*₂ 6–7; distances: *v*₂–*v*₂ 16–18, *v*₂–*sc*₁ 27–32, *sc*₁–*sc*₁ 34–38, *sc*₁–*sc*₂ 22–28, *sc*₂–*sc*₂ 50–56. OPISTHOSOMA similar to protonymph with strong corrugated transverse striations between *sc*₂ and *d*₁, and longitudinal striae posterior to *d*₁, with same setae as adults. Setae *c*₃, *d*₃, *d*₁ and *e*₁ minute, smooth; setae *e*₃, *f*₃ and *h*₁ barbed, and *h*₂ elongate, ending in minute club. Lengths: *d*₁ 4–5, *e*₁ 3, *c*₃ 1–2, *d*₃ 1–2, *e*₃ 2–3, *f*₃ 3–5, *h*₂ 64–98, *h*₁ 3; distances: *d*₁–*d*₁ 10–15, *e*₁–*e*₁ 7–10, *c*₃–*c*₃ 50–52, *d*₃–*d*₃ 35–39, *d*₃–*e*₃ 25–30, *e*₃–*e*₃ 24–30, *e*₃–*f*₃ 5–6, *f*₃–*f*₃ 21–24, *f*₃–*h*₂ 5–7, *h*₂–*h*₂ 14–17, *h*₂–*h*₁ 3–4, *h*₁–*h*₁ 7–11.

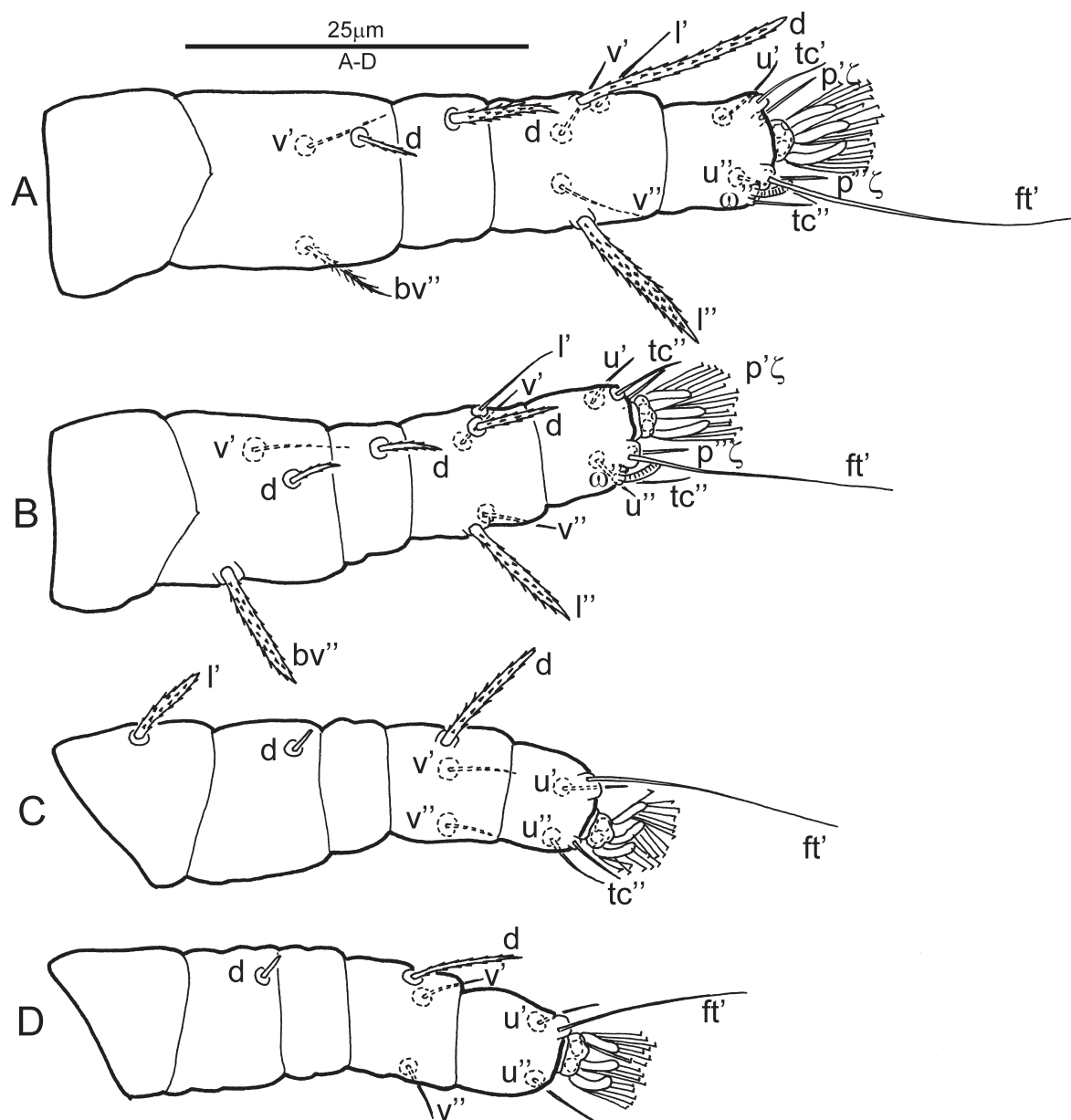


FIGURE 12. *Prolixus meyeriae* sp. nov. (protonymph, right side legs). A, leg I; B, leg II; C, leg III; D, leg IV.

Venter. (Figs. 13B, 14B, D) Similar to protonymph. Setae *1a* flagelliform, *1b* and *3a* setiform. Lengths: *1a* 63–71, *1b* 5–6, *3a* 6–7. Distances: *1a*–*1a* 9–10, *3a*–*3a* 7–10. Posterior opisthosoma with 2 pairs of pseudanal setae (*ps*₁ and *ps*₂), setiform and subequal in length; aggenital and genital setae absent. Setal lengths: *ps*₁ 2–3, *ps*₂ 2–3. Distances: *ps*₁–*ps*₂ 5.

Legs. (Fig. 15) Lengths of legs I–III: 41–45, 37–39, 37–39. Chaetotaxy: coxae 1-0-0; trochanters 0-0-0; femora 3-3-1; genua 1-1-0, tibiae 5-5-3, tarsi 5+ ω -5+ ω -3. Most dorsal and lateral setae on femora I–II, genua I–II and tibiae lanceolate and barbed; dorsal setae *d* on femora III smooth, setiform, lateral setae *l'* on tibiae smooth, setiform. Ventral setae on femora and tibiae setiform; Setae *ft'* on tarsi I–III flagelliform; unguinal setae *u* smooth, setiform. Lengths of solenidia: ta I ω'' 2, ta II ω'' 2. Claws and empodium pad-like with row of paired tenent hairs.

Etymology. The species is named after Magdalena K.P Smith Meyer, who is a distinguished acarologist and has made significant contributions to the systematics and biology of the Tenuipalpidae.

Remarks. This species of flat mite is found living in the tight grooves along the leaf blades of the host plants. They have a greenish-yellow body, which looks translucent and glossy, and is covered by series of minute black spots; legs I–II are obviously orange, and legs III–IV are pale orange; the eyes are red (Fig. 16).

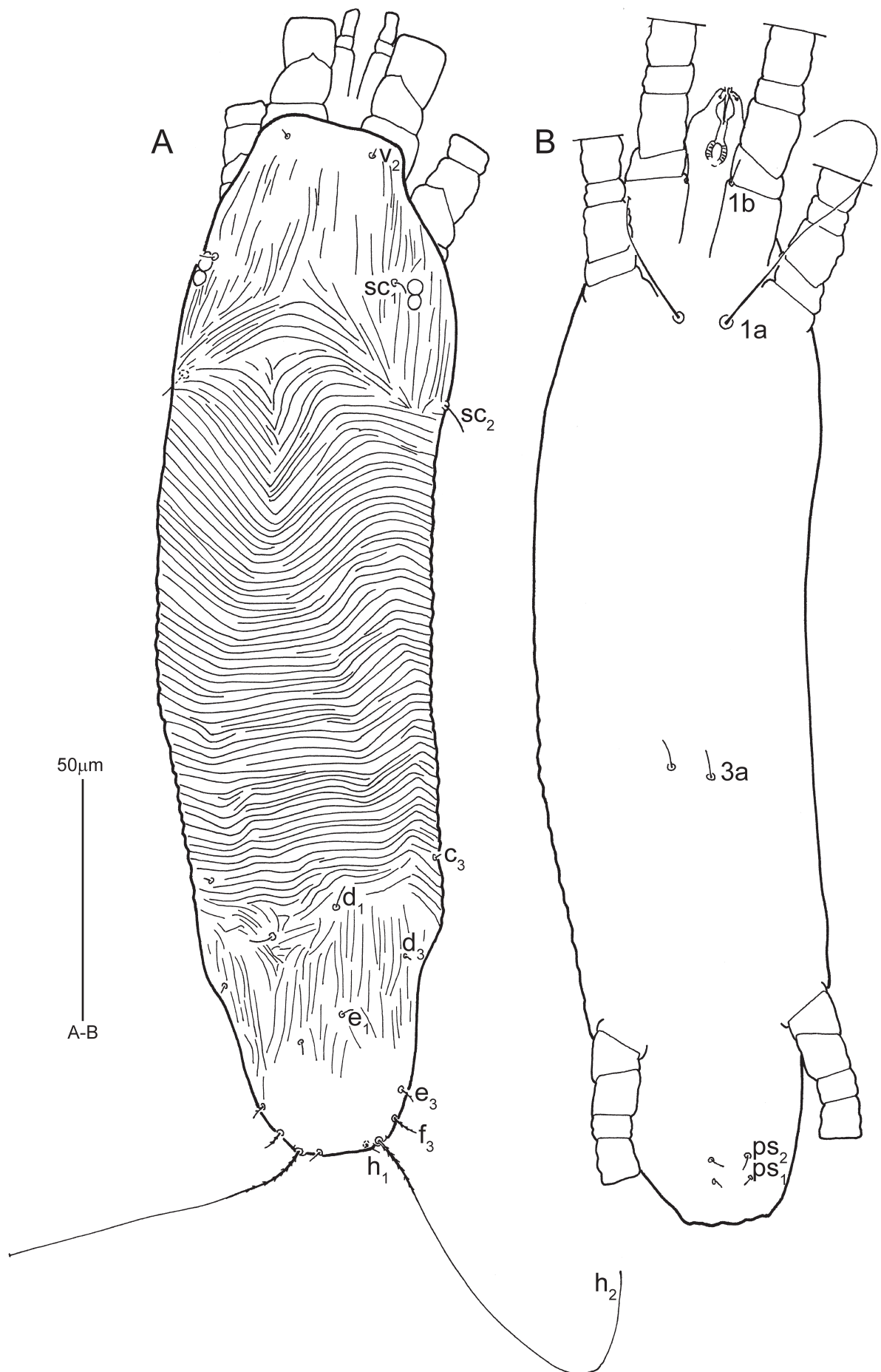


FIGURE 13. *Prolixus meyeræ* sp. nov. (larva). A, dorsal view of idiosoma; B, ventral view of idiosoma.

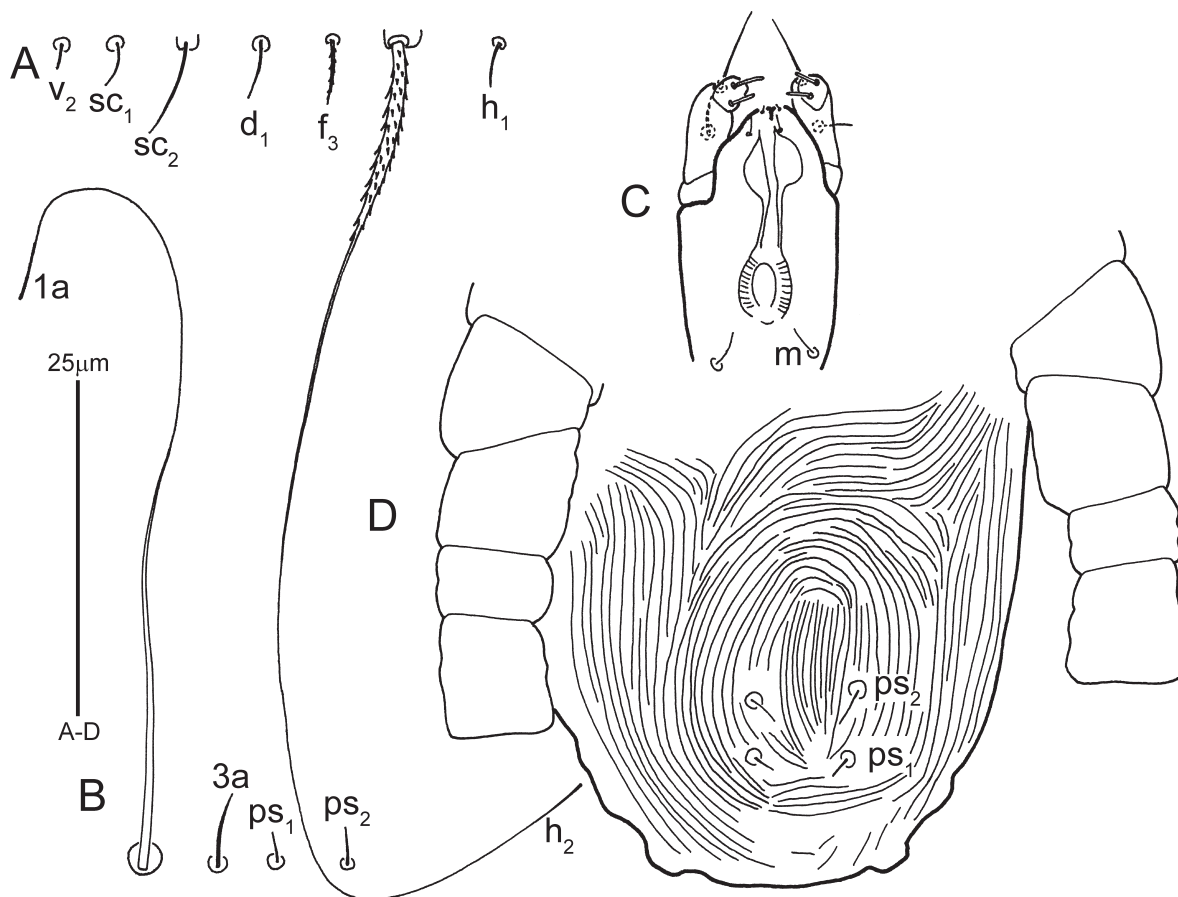


FIGURE 14. *Prolixus meyeriae* sp. nov. (larva). A, dorsal setae; B, ventral setae; C, ventral aspect of distal infracapitulum; D, posterior venter.

The ontogeny of *Prolixus* was reported by Beard *et al.* (2005) and Beard & Ochoa (2011). Setae *1a*, *3a*, *ps*₁ and *ps*₂ are present from the larval stage; *ag*, if present, appear in protonymph; *4a*₁ and *g*₁ appear in deutonymph; *4a*₂ and *g*₂ are added in adult.

The changes in the chaetotaxy of leg segments of three species of *Prolixus* are summarized in Table 1. Larvae of all three species of *Prolixus* have nearly identical leg setal complements, with exception that *P. corruginus* lacks seta *d* on genu II and *P. meyeriae* lacks seta *ev'* on femora III and IV. None of the above three species add any setae to the tibiae throughout development. All *Prolixus* species add tectal setae to tarsi I–III in the protonymph (ta IV in deutonymph): tectal pair is added in *P. forsteri*; only *tc''* is added in *P. corruginus* and *P. meyeriae*. Other differences include: *P. meyeriae* adds *l''* to both genu I and genu II in deutonymph, *P. corruginus* adds *l''* to genu I delayed until the adult and to genu II only in male, while *P. forsteri* adds *l''* to genu I only in male and to genu II in deutonymph; *P. forsteri* adds *l'* to both femur I and femur II in deutonymph; while while *P. corruginus* adds *l'* to femur I delayed to the adult and to femur II only in the male. No setae are added to the femora in *P. meyeriae* throughout development.

Key to species of *Prolixus* (based on adult females)

1. Dorsal opisthosomal setae *f*₂ present; aggenital setae *ag* present; tarsi 7+ω-7+ω-5-5 *P. forsteri* Beard, Fan & Walter
- Dorsal opisthosomal setae *f*₂ absent; aggenital setae *ag* absent; tarsi 7+ω-7+ω-4-4 2
2. Prodorsal setae *sc*₁ barbed, as long as *sc*₂; ventral setae *1c*, *3b* and *4b* absent; trochanters 0-0-0-0; femora 4-3-2-2 (fe I with setae *d*, *l'*, *v'*, *bv''* present; fe III–IV with setae *d*, *ev'* present); genua 2-1-0-0 (ge II with seta *d* present; *l''* absent) *P. corruginus* Beard, Fan & Walter
- Prodorsal setae *sc*₁ setiform, *sc*₂ about five times as long as *sc*₁; ventral setae *1c*, *3b* and *4b* present; trochanters 0-0-1-0 (*l'* present on tr III); femora 3-3-1-1 (fe I with *d*, *v'*, *bv''* present; *l'* absent; fe III–IV with *d* present; *ev'* absent); genua 2-2-0-0 (ge II with *d*, *l''* present) *P. meyeriae* sp. nov.

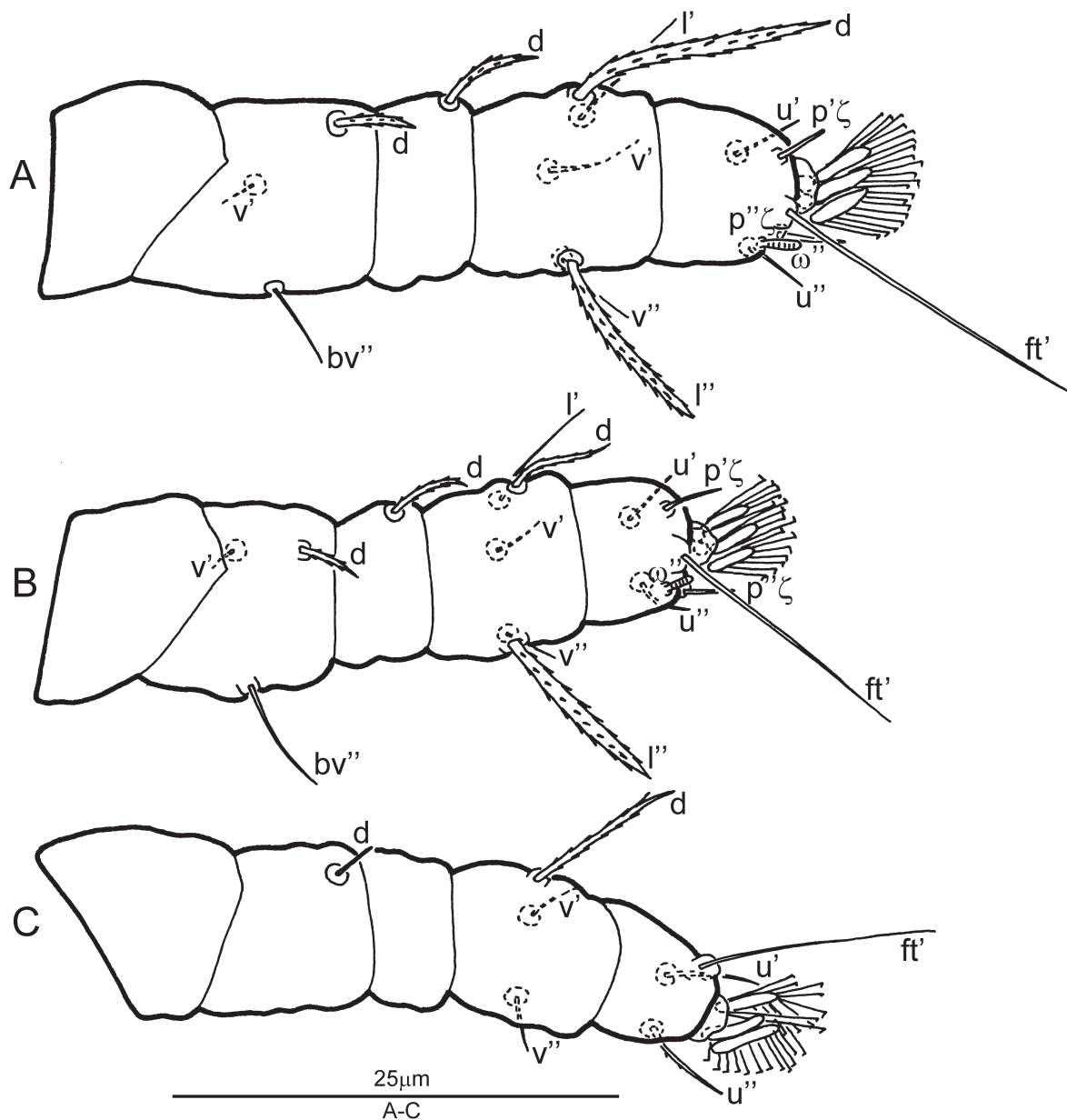


FIGURE 15. *Prolixus meyeriae* sp. nov. (larva, right side legs). A, leg I; B, leg II; C, leg III.

TABLE 1. Ontogeny of leg chaetotaxy in *P. corruginus* (Pc), *P. forsteri* (Pf) and *P. meyeriae* (Pm). Setae are indicated where they are first added. Setae in parentheses represent pairs. Hyphen indicates no additions.

	Coxae	Trochanters	Femora	Genua	Tibiae	Tarsi
Leg I						
Larva—Pc	<i>lb</i>	-	<i>d, v', bv''</i>	<i>d</i>	<i>d, (l), (v)</i>	<i>(u), (pζ), ft', ω''</i>
Pf	<i>lb</i>	-	<i>d, v', bv''</i>	<i>d</i>	<i>d, (l), (v)</i>	<i>(u), (pζ), ft', ω''</i>
Pm	<i>lb</i>	-	<i>d, v', bv''</i>	<i>d</i>	<i>d, (l), (v)</i>	<i>(u), (pζ), ft', ω''</i>
Protonymph—Pc	-	-	-	-	-	<i>(tc)</i>
Pf	-	-	-	-	-	<i>(tc)</i>
Pm	<i>lc</i>	-	-	-	-	<i>(tc)</i>
Deutonymph—Pc	-	-	-	-	-	-
Pf	-	<i>v'</i>	<i>l'</i>	-	-	-
Pm	-	-	-	<i>l''</i>	-	-

.....continued on the next page

TABLE 1 (continued)

	Coxae	Trochanters	Femora	Genua	Tibiae	Tarsi
Female—Pc	-	-	l'	l''	-	-
Pf	-	-	-	-	-	-
Pm	-	-	-	-	-	-
Male—Pc	-	v'	l'	l''	-	ω'
Pf	-	-	-	l''	-	ω'
Pm	-	-	-	-	-	ω'
Leg II						
Larva—Pc	-	-	d, v', bv''	d	$d, (l), (v)$	$(u), (p\zeta), ft', \omega''$
Pf	-	-	d, v', bv''	-	$d, (l), (v)$	$(u), (p\zeta), ft', \omega''$
Pm	-	-	d, v', bv''	d	$d, (l), (v)$	$(u), (p\zeta), ft', \omega''$
Protonymph—Pc	$2c$	-	-	-	-	(tc)
Pf	$2c$	-	-	-	-	(tc)
Pm	$2c$	-	-	-	-	(tc)
Deutonymph—Pc	$2b$	-	-	-	-	-
Pf	$2b$	-	l'	l''	-	-
Pm	$2b$	-	-	l''	-	-
Female—Pc	-	-	-	-	-	-
Pf	-	v'	-	-	-	-
Pm	-	-	-	-	-	-
Male—Pc	-	v'	l'	l''	-	ω'
Pf	-	v'	-	l'	-	ω'
Pm	-	-	-	-	-	ω'
Leg III						
Larva—Pc	-	-	d, ev'	-	$d, (v)$	$(u), ft'$
Pf	-	-	d, ev'	-	$d, (v)$	$(u), ft'$
Pm	-	-	d	-	$d, (v)$	$(u), ft'$
Protonymph—Pc	-	-	-	-	-	tc''
Pf	$3b$	l'	-	-	-	(tc)
Pm	$3b$	l'	-	-	-	tc''
Deutonymph—Pc	-	-	-	-	-	-
Pf	-	v'	-	-	-	-
Pm	-	-	-	-	-	-
Female—Pc	-	-	-	-	-	-
Pf	-	-	-	-	-	-
Pm	-	-	-	-	-	-
Male—Pc	-	-	-	-	-	-
Pf	-	-	-	-	-	-
Pm	-	-	-	-	-	-
Leg IV						
Protonymph—Pc	-	-	d, ev'	-	$d, (v)$	$(u), ft'$
Pf	-	-	d, ev'	-	$d, (v)$	$(u), ft'$
Pm	-	-	d	-	$d, (v)$	$(u), ft'$
Deutonymph—Pc	-	-	-	-	-	tc''
Pf	$4b$	-	-	-	-	(tc)
Pm	$4b$	-	-	-	-	tc''
Female—Pc	-	-	-	-	-	-
Pf	-	v'	-	-	-	-
Pm	-	-	-	-	-	-
Male—Pc	-	-	-	-	-	-
Pf	-	v'	-	-	-	-
Pm	-	-	-	-	-	-

* Leg IV absent in larva.



FIGURE 16. *Prolixus meyeri* sp. nov. (dorsal view of idiosoma). A, female; B, male; C, deutonymph; D, protonymph; E, larva.

Acknowledgements

We are grateful to Dr Nicholas A. Martin (Landcare Research, Auckland, New Zealand) for collecting the specimens of this new species and two anonymous reviewers for constructive comments. The first author is grateful to Prof Jia Luo and Mei-Xiang Wu (Fujian Agriculture and Forestry University, China) for their continuous support in providing access to lab and equipment. While this paper was prepared, Zhi-Qiang Zhang was supported by Core funding for Crown Research Institutes from the Ministry of Business, Innovation and Employment's Science and Innovation Group.

References

- Beard, J.J., Fan, Q.-H. & Walter, D.E. (2005) A new genus and two new species of Tenuipalpidae (Prostigmata: Tetranychoidae) from an Australian sedge. *Acarologia*, 45, 161–181.
- Beard, J.J. & Gerson, U. (2009) A new flat mite genus, *Acaricis* (Prostigmata: Tenuipalpidae), from Australian sedges (Cyperaceae). *Zootaxa*, 2073, 31–44.
- Beard, J.J. & Ochoa, R. (2011) New flat mite genera (Acari: Trombidiformes: Tenuipalpidae) associated with Australian sedges (Cyperaceae). *Zootaxa*, 2941, 1–37.
- Beard, J.J., Ochoa, R., Baughan, G.R., Trice, M.D., Redford, A.J., Walters, T.W. & Mitter, C. (2013) Flat Mites of the World. Edition 2. Identification Technology Program, CPHST, PPQ, APHIS, USDA; Fort Collins, CO. Available from: <http://idtools.org/id/mites/flatmites/> (Accessed 16 Oct. 2014)
- Beard, J.J., Seeman, O.D. & Baughan, G.R. (2014) Tenuipalpidae (Acari: Trombidiformes) from Casuarinaceae (Fagales). *Zootaxa*, 3778 (1), 1–157.
<http://dx.doi.org/10.11646/zootaxa.3778.1.1>
- Lindquist, E.E. (1985) External anatomy. In: Helle, W. & Sabelis, M.W. (Eds), *Spider Mites: Their Biology, Natural Enemies and Control*. Vol. 1a. Elsevier, Amsterdam, pp. 3–28.
- Mesa, N.C., Ochoa, R., Welbourn, W.C., Evans, G.A. & de Moraes, G.J. (2009) A catalog of the Tenuipalpidae (Acari) of the World with a key to genera. *Zootaxa*, 2098, 1–185.
- Navajas, M. & Ochoa, R. (2013) Integrating ecology and genetics to address Acari invasions. *Experimental and Applied Acarology*, 59, 1–10.
<http://dx.doi.org/10.1007/s10493-012-9636-8>
- Wang, H.-F. (1983) New species of the genus *Tenuipalpus* from China (Acarina: Tenuipalpidae). *Acta Zootaxonomica Sinica*, 8(1), 51–62.
- Xu, Y. & Zhang, Z.-Q. (2013) New Zealand Tenuipalpidae (Acari: Trombidiformes): A new species of *Acaricis* from Cyperaceae and its ontogenetic patterns in chaetotaxy. *Systematic & Applied Acarology*, 18 (4), 357–388.
<http://dx.doi.org/10.11158/saa.18.4.6>
- Zhang, Z.-Q. & Fan, Q.-H. (2004) Redescription of *Dolichotetranychus ancistrus* Baker & Pritchard (Acari: Tenuipalpidae) from New Zealand. *Systematic & Applied Acarology*, 9, 111–131.
- Zhang, Z.-Q., Fan, Q.-H., Pesic, V., Smit, H., Bochkov, A.V., Khaustov, A.A., Baker, A., Wohltmann, A., Wen, T.-H., Amrine, J.W., Beron, P., Lin, J.-Z., Gabrys, G. & Husband, R. (2011) Order Trombidiformes Reuter, 1909. In: Zhang, Z.-Q. (Ed.) *Animal biodiversity: an outline of higher-level classification and survey of taxonomic richness*. *Zootaxa*, 3148, 129–138.